

Solar Energy, Technology Policy, and Institutional Values

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Introduction

Solar Energy, Ideas, and Public Policy

On June 20, 1979, President Jimmy Carter dedicated the solar hot water heating system newly installed in the West Wing of the White House. A “Who’s Who” of solar energy advocates joined him at that ceremony. Although they provided part of the White House’s hot water needs, the solar collectors served more importantly as a symbol of Carter’s commitment to promoting solar energy to meet the nation’s energy needs. This ceremony marked the symbolic height for solar energy within the executive branch. Not only did the president announce new policy initiatives, he did so while publicly associating himself with the activists and government officials who had been pushing for them, and all of this against the backdrop of solar collectors on the White House roof. No activist could ask for a better scene and set of props. The event was not only a symbolic peak but a policy peak as well, for solar had never before been treated by the federal government with such generosity or seriousness.¹

Yet, as in any theater, scenes and symbols can mislead as well as inform. The White House ceremony conveyed the impression of solar advocates’ great success as President Carter announced policies for which they had been fighting for years. Since many of these very same people had pushed successfully for new environmental laws and institutions, one could conclude that a new movement and its leaders had acquired the resources and skills to influence government policy decisively. Yet such a conclusion would be mistaken. Solar advocates’ successes largely evaporated when Ronald Reagan assumed the presidency eighteen months later. But even while Jimmy Carter was president, their influence in the executive branch eroded severely, beginning only weeks after this ceremony. Moreover, the activists were well aware of the limits of their influence and of President Carter’s commitment to their cause. Even at the White House ceremony, they complained to reporters that Carter’s policy initiatives were inadequate – barely the minimum that the solar

community would accept.² How could their success be so illusory and ephemeral?

To understand the development of solar energy policy we need to analyze a historical chain of events over a period of decades, paying close attention to the dynamic interrelationships of ideas, interests, and institutions, both in solar energy policy and in energy policy more generally. The conceptual framework for this analysis, and part of its contribution to understanding technology policies more broadly, is a long-term longitudinal case study that analyzes how key ideas, both technical and normative, enabled actors to frame problems and understand their interests, and how such ideas got embedded in institutions.

IDEAS IN PUBLIC POLICY

In the last decade numerous scholars have argued for the importance of ideas in shaping public policy. They have each conceptualized ideas slightly differently, calling them beliefs, knowledge, values, ideology, and so on, and have analyzed an assortment of ways in which those ideas enter and influence the policy process. Central to all of these analyses, despite their differences, is the notion that either normative or technical ideas, or a combination of both, play a role in setting and changing policy, a role that is not simply a derivative of other more traditional influences on policy, such as interests or institutional structures.

For example, Peter Haas argues that consensual scientific and technological knowledge can be embodied in transnational scientific entities called epistemic communities. Such communities can play crucial roles in international policy making, particularly in facilitating cooperation among states, by helping governments to understand the nature of transnational problems and their feasible solutions. Epistemic communities are bound together by both shared scientific knowledge and shared normative notions about the importance of the problems under study. This combination of normative and technical ideas can influence policy because it can present decision makers with consensual interpretations of uncertain events and provide legitimation to policy decisions, particularly when members of the epistemic community become officials in government ministries. Epistemic communities can help decision makers understand what their interests are in uncertain environments.

In Haas's analysis, ideas gain their force from their acceptance and promotion by a transnational community of experts, and that community's importance derives from its relationship to various governing institutions. Haas does not overplay the importance of epistemic com-

munities, noting that government policy makers sometimes elect to ignore expert recommendations. He argues that the power of the ideas depends on whether the community members are able to garner bureaucratic power.³ The field of solar energy had a group of experts that comprised an epistemic community. However, just at the time that it began to achieve some bureaucratic power it also began to unravel in terms of its technical and normative cohesion.

John Kingdon, in his study of agenda setting and public policy, argues that ideas are more important in promoting policy than many analysts of politics and policy think. Interest group pressures certainly affect policy, but the substantive content of policies also influences their success, in particular the coherence and persuasiveness of policy advocates' arguments. At any given time numerous policy ideas float around policy systems, and the important question is why some of them take hold and others do not. Policy communities, groups of technical specialists in and out of government, champion various policy ideas. Policy communities resemble Haas's epistemic communities, except that a policy community may or may not share a consensus about the most desirable ideas for some particular policy. Ideas influence policy in Kingdon's analysis because organized institutional forces champion them and so use them in the policy system.⁴

Deborah Stone argues persuasively that ideas about public policy are both the instruments that partisans fight with and, just as importantly, the goals that they fight for:

Ideas are a medium of exchange and a mode of influence even more powerful than money and votes and guns. Shared meanings motivate people to action and meld individual striving into collective action. Ideas are at the center of all political conflict. Policy making, in turn, is a constant struggle over the criteria for classification, the boundaries of categories, and the definition of ideals that guide the way people behave.

Stone develops an analysis of how ideas play out in setting policy goals, framing problems, and evaluating solutions. She shows that groups and individuals fight over and negotiate the detailed meanings of ideas like equity and liberty in the context of particular policy controversies, and that such meanings can change over time as well as across issues.⁵ Stone has much in common with Haas and Kingdon, although she gives a higher priority to the processes of developing shared meanings of normative ideas and less to the use of technical knowledge as a political resource. She also provides numerous tools to analyze the ideas that partisans express in their policy analyses and pronouncements.

Donald Schön and Martin Rein discuss the ways in which ideas coalesce into frames, which they describe as the "underlying structures of

belief, perception, and appreciation” through which people make sense of and understand their world, particularly in the cases of difficult, intractable policy controversies. Frames can be either quite specific to a particular policy problem or broadly shared cultural understandings. Disputants in policy controversies usually employ different frames, which makes communication between them difficult and the controversies hard to resolve.⁶

These authors and others share several key notions about the role of ideas in public policy, despite their many differences of emphasis and conceptualization. First, they stress the importance of ideas in policy making, claiming that such importance is often overlooked. They also stress that ideas, whether normative or technical, enable people to make sense of the world, to understand the circumstances of their lives and what courses of action will serve them best. Finally, they argue that a shared understanding of ideas can provide the means to collective action. Of course, ideas do not determine policy exclusively. They interact dynamically with other, more traditional policy variables, such as interests and institutions. As Hugh Heclo has argued, one should analyze the interactions of ideas, interests, and institutions, instead of assuming *a priori* the importance of one over the other two.⁷

Ideas, interests, and institutions interact in a variety of ways. For example, interests are not simply things that we have which were given to us in some mysterious way. Ernst Haas argues that we need knowledge (a form of ideas) to understand what our interests are. Identifying something as “in our interest” means that we have normative ideas that shape our concept of what is good for us and technical ideas that some course of action will move us toward that good situation and so benefit us. In addition, new knowledge or new technological opportunities may cause us to change what we perceive to be our interests.⁸ This and other analyses make a persuasive case that what we think of as interests are in fact influenced by the ideas that we and others hold. Of course, this interpretation does not exclude the other relationship – that the ideas we hold are related to our interests. The point is to ensure that we do not reduce ideas to some cynical derivative of interests, since ideas are actually constitutive of interests.

One difficulty in the analysis of ideas in policy derives from the blurry distinction between normative ideas (values) and positive ideas (facts and empirical concepts). Actors base their positions on both types of ideas, and often one cannot cleanly separate the facts from the values in a policy argument.⁹ Even more important in this analysis, partisans in a policy dispute will argue over just where that boundary is, wanting to put as much of their argument in the “facts” category and as much of their opponents’ argument in the “values” category as possible. Sheila

Jasanoff analyzes this boundary work when scientific advisory committees try to assert what constitutes a scientific consensus in contentious technical issues. She concludes that successful boundary work establishes the boundary in a broadly accepted way and so stakes out part of the issue as the province of scientists and engineers, and that this sort of firm boundary is necessary for closure on some issues. Partisans in energy policy disputes often do contest such boundaries as a way of trying to influence a policy debate and a firm boundary is one barrier to contesting and reopening the way in which an issue is framed and conceptualized.¹⁰

Energy policy advocates are motivated by the meanings they attach to the technologies they advocate. Trevor Pinch and Wiebe Bijker delineate social groups that are relevant to some technology because they all accept a shared meaning for the technology. The technology is not merely some good that they produce or consume, but has a more complex set of meanings associated with it. Pinch and Bijker explain that technologies have interpretive flexibility in that different groups may design them differently and attach different meanings to them.¹¹ If we are interested in policy conflicts, we need to understand the political and social meanings that different energy technologies have to participants in the policy debates.

Analyses of technology-based policies need a framework that links particular technological choices with different sets of ideas. If ideas, with their complex mixture of normative and technical components, influence people's choices of energy technology, how can we make inferences that connect the choices with the ideas and attendant meanings? Langdon Winner provides a concept that we can use as an interpretive scheme: technology as legislation. Winner argues that certain technological ensembles – large systems that produce major goods and services such as food, energy, transportation, and communications – are more than mere tools. They are constitutive parts of modern life. This concept does not imply any notion of technological determinism but instead suggests that in making large-scale technological choices we are choosing systems that will encourage some forms of political and social life and discourage others. “*Different ideas of social and political life entail different technologies for their realization.*”¹² Winner intended this concept as a way of analyzing extant technological systems. I am using it differently, as an interpretive tool for understanding the meanings that drive people to favor certain choices of technological systems over others.

Partisans in the debate over emergent energy technologies clearly associated their preferred technologies with their larger visions of a desirable way of life. These political and social visions were most overtly tied to energy technology choices during the 1970s, but they were

still present, although more implicitly, in the writings of energy advocates throughout the period of this study. It follows that analyzing debates over government policies about future energy technologies must take into account various actors' views of the good polity and society, that is, their normative political and social ideas. It does not matter for my analysis whether or not partisans were correct in thinking that certain energy technologies would in fact lead to their desired society. What does matter is that partisans *thought* that certain technological choices would lead to political and social goals and that a shared meaning of the technology, correct or not, drove their advocacy. Therefore, the notion of technology as legislation provides a framework for helping us to extract partisans' normative and technical ideas from their policy arguments, providing an explanation for why certain energy policies dominated decision making. This framework will facilitate analysis of the way in which actors in the policy process perceived energy policy problems and solutions. In sum, my framework has two different parts: It analyzes the dynamic interplay of ideas, interests, and institutions; and it uses the concept of technology as legislation to understand and interpret that interplay in the case of solar energy policy. The framework also can readily apply to other significant emergent technologies.

POLICY FOR THE FUTURE

While ideas are important in virtually all policy issues, they are especially important in a certain class of policies – those that deal heavily with the future and its attendant uncertainty – and so for which we can make few confident predictions. While all policies involve uncertainty, these issues are particularly burdened by it, and the uncertainty is so deep that it may approach simple ignorance. Policies concerned with developments, both social and technological, ten or twenty years hence must confront the various and widely divergent paths that those developments can take. The specific consequences of such developments may be as unpredictable as the developments themselves. For example, it is impossible to predict what percentage of our electricity will come from renewable sources in thirty years and what percentage from the traditional sources of coal, oil, and natural gas. In addition, it is hard to say which renewable technologies will be used the most heavily and in what manner. Furthermore, it is not always possible to predict the differential impacts of using various energy technologies, even if relative directions are clear. Yet those technological developments will influence what we pay for the electricity, how it affects the environment, how much oil we have to import, the structure of the utility industry, the ways in which that industry is regulated, and a host of other social and political questions. Moreover, poli-

cies that we implement now – including resources for research and development, regulations on existing utilities, subsidies for renewable energy, and the advent of competition in the utility industry – will strongly influence which technologies look the most attractive in thirty years, so that we are, in part, creating our future, despite its uncertainty. Under such immense technical uncertainty, people's ideas about what constitutes a good political and social order, and which institutional and technological arrangements they think will further that order, come to dominate policy-making debates, since long-term interests are hard to identify and predict and institutions may be embryonic or nonexistent.

Numerous technology policy issues, including some parts of energy policy, fall into this uncertain-future category, and so they require far better understanding. Solar (often used interchangeably for the broader category of renewable) energy policy in the decades since World War II presents important conceptual and pragmatic questions for policy scholars. It calls for refining conceptual tools for understanding policy change and development, as well as the incorporation of recent work on the politics and sociology of technology. Pragmatically, it is an important substantive issue in itself, and, as an emergent technology, is also part of this broader set of future-oriented, highly uncertain policies for which governments need to be better prepared. An analysis that stresses the role of ideas and their interaction with interests and institutions offers several strengths. It provides a more nuanced account of the process of policy making itself, both for the case in question and more generally. It also helps us discover why it is that we have the solar energy policy that we do. More importantly, such an integrated approach also enables us to determine how policy can be made better in the context of a democracy struggling with difficult long-term technological issues. An analysis of the dynamics of policy making suggests the dimensions along which we might seek improvement. What policy should we have for solar energy, and how could we imagine getting it?

Edward J. Woodhouse, David Collingridge, and a few other scholars have begun to articulate a set of criteria and an analytical framework through which we can make such evaluations. They argue that, for technology policies plagued with uncertainty, policy makers should seek to tap the intelligence of democracy by incorporating views from a wide variety of possible participants, avoid large mistakes, maintain their flexibility, and use feedback to learn about and improve the policies.¹³ This prescription means that better energy policy making would include the views of a more diverse array of people and fulfill the substantive criteria of flexibility and feedback.¹⁴ The question immediately arises of how to improve policy making so that policies better fulfill these criteria. In the case of solar energy, in many instances various actors did try to

increase the range of voices speaking to policy makers, but those efforts had negligible, or in one case limited, success. This case study demonstrates why it is so hard to make these sorts of improvements in policy. It is not enough for more voices to speak to policy makers. They must speak in a way that is consistent with the dominant problem definition or frame, or seek to change it.

An understanding of the *dynamics* of the policy-making process gives us a better idea of how to change it to make better solar policy and better technology policies more generally. Given the importance of ideas in policy making and the way they shape interests and interact with institutions, concerns for democracy suggest that key institutions and actors be more open to ideas that challenge conventional views of the world, and that policy debate within those institutions be structured so as to provide critical reflection on the ideas that underlie policy and often go unchallenged. In short, the policy-making process should be made more democratic by opening it up to include better debate about the normative goals that we seek with our technological policies. Others have made this suggestion, but the analysis presented here makes it clear that conventional pluralist methods of participation fall far short of this goal, given the often subtle ways that ideas influence policy. Pluralist notions of democracy depict participation as the actions of organized groups in gaining access to and trying to influence decision makers. Given the fragmented and allegedly permeable nature of the American state, groups can choose among many routes into policy making.¹⁵ In this view, groups are limited only by their political resources and skill in using them, assuming a fair policy process in which all groups so inclined have the opportunity to make their voices heard. This framework has much to commend it, but it misses some crucial parts of the policy process, and I will show that even a process that is explicitly designed to open up policy making to alternative conceptions of values, problems, and solutions can fail to do so by failing to address the problem of the institutionalization of ideas explored here.

PROBLEM FRAMES

If ideas are important in public policy, then we must analyze how they enter into and affect the policy process. To understand how ideas interact with interests and institutions and why those interactions affect outcomes, we need to look in detail at how ideas give us a particular depiction of a problem, often called problem definition or problem framing, and how they influence decision makers' evaluations of potential solutions to the problem. Problem frames do not determine policy outcomes in any simple sense, but they do have immense influence on them. Donald Schön and Martin Rein show that frames enable us to con-

struct stories about our policy problems that make the “normative leap” from analyzing a problem to saying what one ought to do about it. If that story is well-constructed, the final normative leap will seem like the natural outcome, the only reasonable one.¹⁶

At the most specific level this analysis asks, how did advocates and policy makers between 1946 and 1981 frame solar energy technology? How did they conceptualize its then present status and future potential? How did they conceptualize energy policy more generally, and how did solar as a future option fit into that broader frame? What sorts of ideas did these specific and more general frames express, and how did actors try to change those ideas and frames? All of these questions require detailed empirical accounts for answers. In doing this long-term case study I developed a detailed understanding of the ways in which ideas and their associated problem frames got institutionalized as well as the formidable barriers to institutionalizing new ideas; it is more difficult to change institutionalized ideas than analysts often assume. The difficulty in altering institutionalized ideas points us toward the crucial parts of the policy process that must change if we are to have policies that retain flexibility, learn from experience, and incorporate diverse communities and ideas. Nowhere are these considerations more important than in policies concerning emergent technology, where the immense factual and conceptual uncertainties reinforce the importance of actors’ values.

Numerous scholars have noted the importance of normative ideas in energy policy debates and attempted to document their influence.¹⁷ A few scholars have studied in more detail the roles that particular values have played in energy debates and the values that advocates claimed were associated with certain energy technologies.¹⁸ Partisans in these debates linked technological choices to social outcomes, even if only implicitly and even if the technological system they advocated would not, in fact, bring about the kind of society that they desired.¹⁹ Moreover, the ways in which actors talked about the policies and energy systems that they desired tell us much about the normative ideas that underlie their proposals.²⁰

INSTITUTIONS AND PROBLEM FRAMES

Problem frames, and the ideas that constitute them, operate within institutions. As Schön and Rein put it, “Frames are not free-floating but are grounded in the institutions that sponsor them.”²¹ Other scholars agree. Judith Goldstein and Robert O. Keohane argue that ideas become powerful when they become institutionalized, and that such deeply embedded ideas can explain the phenomenon of policy inertia, of institutions sticking to a policy long after one might have expected it to change.²²

To understand the ways that ideas, problems, frames, and so on influence public policy, we must investigate the ways in which ideas get institutionalized. Particular ideas come to dominate the official definition of a problem and the conceptualization of its possible solutions. These ideas also shape the institution's rules, organizational norms, and operating procedures.

Substantial, enduring changes in policy require changes in the institutionalized ideas that influence policy, which can mean either changing ideas within an institution or changing which institution controls some policy. Frank Baumgartner and Bryan D. Jones emphasize the latter to change institutionalized ideas and policies:

This [policy] process is the interaction of beliefs and values concerning a particular policy, which we term the policy image, with the existing set of political institutions – the venues of policy action. In a pluralist political system, subsystems can be created that are highly favorable to a given industry. But at the same time, there remain other institutional venues that can serve as avenues for appeal for the disaffected.²³

In short, if some policy advocates consistently fail to get the policy they want from some government institution, they can try taking their arguments to a different institution, perhaps a different congressional committee or executive branch agency. Jurisdiction over policy areas sometimes changes, and if that new institution becomes dominant, then the policy can change rapidly. The difficulty with this solution is that the new institution may not end up having decisive influence over the policy of concern, which in fact is what happened in the case of solar energy policy.

Alternatively, advocates can stick with the dominant institution and try to change the ideas that guide it. New ideas can change the meaning or understanding associated with some policy solution, in this case a technology, so that it looks like a more plausible solution to an old problem. Similarly, changes in ideas can change the way the problem is framed, so that the relevant government officials consider as a plausible solution technologies that they previously rejected or did not even take seriously.

Maarten Hajer's work on discourse coalitions alerts us to an important pitfall in the analysis of institutionalized ideas used to explain policy change, or the lack of it. He describes discourses as "an ensemble of ideas, concepts, and categories through which meaning is given to phenomena. Discourses frame certain problems, that is to say, they distinguish some aspects of a situation rather than others." The relationship of Hajer's discourses to the ideas and frames discussed above is obvious. He reminds us that we cannot conclude that ideas are influencing policy

just because some institution has started using a particular discourse in its statements, but that we must look at the institution's practices and decisions before we conclude that the particular discourse has become institutionalized and dominant in some part of policy making. Important actors may start speaking the stories of a new discourse, what he calls discourse structuration, but we must also analyze what the institutions *do* to see which discourses are in fact institutionalized.²⁴

For the case of solar energy, and other future-oriented energy policies, we need to analyze which government officials were in a position to influence this kind of change and the institutional structures in which they operated, including the means by which nongovernmental actors had access to them. We will also need to analyze the ways that institutionalized ideas shaped the official definitions of problems and how some actors tried to change those definitions. The ideas held at the top levels of policy making, especially in the executive branch, are more important than are usually given credit in the policy literature. In the solar case, what appeared to be a substantial and enduring change during the 1970s, particularly at the agency level, was in fact ephemeral because, in part, of the stability of the way the issue was defined at the presidential level, despite vigorous efforts to change that definition. Making a large change in this type of institutionalized problem frame entails dramatic changes in a massive part of the nation's technological infrastructure, with all the accompanying political, economic, and social changes. Such policy changes must have high-level support, since they will conflict with many other ideas, goals, and interests held by previously persuasive stakeholders and hence encounter stiff resistance from those who prize the status quo.²⁵ Thus the key for this study will be how new values were, or were not, institutionalized in the Executive Office of the President (EOP). I will also analyze congressional actions to some extent, but on solar energy policy these were mostly reactive to executive branch actions, even in the late 1970s. The EOP was the key barrier to substantial energy policy change.

I do not mean by these comments to dismiss Congress as an important influence on policy. Assorted energy advocates used congressional committees very successfully as a means of promoting their technologies and keeping pressure on the executive branch. This pressure was felt most intensely in the appropriations process. My analysis will carefully depict the interaction of the Congress with energy advocates and the executive branch. That said, this analysis still focuses primarily on the executive branch because it retained the ability to set the dominant frame for the issue. Throughout the history of energy policy, the president and his advisors remained the crucial actors for undertaking new policy initiatives linked to new ideas about policy.

WEAKNESSES OF CONVENTIONAL ANALYSES

Despite their surface appeal, conventional analyses based on interest groups, simple notions of ideology, or rational economic calculations all fail to explain adequately the detailed chain of events in solar energy policy. A simple pluralistic look at the interest groups that supported solar energy could lead one to believe that it would have been generously supported and a high priority for policy makers, contrary to the actual history of solar policy. In addition to solar advocacy groups themselves, solar has gotten the enthusiastic backing of well-known environmental groups since the 1970s. Particularly vexing for interest group theory is that solar advocates' political resources stayed roughly constant during the time that solar policy was changing radically. To respond that the groups gained and then lost their influence in that short period of time (roughly 1974 to 1980) merely restates the question to be answered.²⁶ Solar has also enjoyed the strong support of the general public. Indeed, for decades public opinion polls have shown solar energy and energy efficiency to be the public's top choice for the energy technologies in which the government should invest for the future.²⁷ These polls, which political leaders allegedly watch so closely, clearly do not translate into public policy in any simple way.

A simple ideological explanation also fails to explain these outcomes. It is not enough to say, for instance, that President Reagan was opposed to solar on ideological grounds. Support for solar energy was declining sharply in top policy circles while President Carter was still in office. Moreover, the simple ideological explanation begs the more important question: Why were the values associated with solar technologies so anathema to conservatives? In earlier decades solar technologies had been championed by conservative advocates, and understanding how solar came to have particular values imputed to it requires a much longer and deeper historical perspective.

Rational economic calculation also fails to explain the government's actions. Policy makers faced great uncertainty when trying to decide about future energy options. We must base our explanations of their actions in terms of what knowledge was available to them at the time that they made their decisions.²⁸ In the early decades after World War II, solar's economic and technical feasibility appeared no more uncertain than other energy options into which the government was willing to invest massive resources, most especially nuclear power. Moreover, the government changed its policies in ways that were not justified by short-term fluctuations in fuel – especially oil – prices, as will be detailed in later chapters. For example, from 1980 to 1982, government solar research and development (R&D) funding fell drastically while the price

of oil rose or declined only slightly.²⁹ My criticisms of simple ideological, interest-based, and rational economic calculation frameworks for understanding solar energy policy suggest that a full analysis needs a different approach, though, to be sure, those traditional variables will crop up repeatedly in my account.

The analysis here, by emphasizing the interaction of ideas with interests and institutions, will give us a better understanding of the reasons for the volatile fate of solar policy and how it fits into energy policy more generally. This analysis will also suggest how those who favor solar energy can better go about seeking policy support for it.

IMPORTANCE OF THE CASE

The broad importance of energy to all aspects of life in industrial societies needs little discussion. Energy is part of every major technological activity, from agriculture and manufacturing to transportation and telecommunications. The roots of energy policy stem from the U.S. government's deep involvements in energy technologies, resources, and markets, an involvement that goes back over a century and shows no indication of disappearing.³⁰

The government has been and continues to be involved in the research and planning for future energy resources. The Cold War powerfully influenced federal government R&D priorities, and energy, especially nuclear energy, technologies figured prominently in those programs.³¹ The Cold War influence went beyond picking R&D priorities. As Stuart W. Leslie has argued, the military security orientation of such programs led technology and science policy in particular directions, emphasizing state-of-the-art high performance often at the expense of technologies that could have important applications in the civilian economy.³²

Such planning for the future seemed an immediate and pressing matter during most of the 1970s. It seems less so today, although there is no reason that it should. Planning for the future should not wait until a crisis strikes. Recent price increases remind us that the current low prices and ample supply of oil will not last indefinitely. A recent survey of studies of recoverable crude oil argues that world oil production is likely to peak somewhere between the years 2007 and 2014, and this conclusion does not assume any political events that will interrupt production.³³ Energy could be a front-page issue again before long.

Solar energy – or renewable energy, as such sources are usually called now – has the potential to be a major part of the world's energy sources as fossil fuels decline in production. As we will see, advocates have long depicted renewables as the resource that will enable the continuation of industrial civilization after the era of fossil fuels, and a recent spate of

books and studies have updated and promoted that conclusion. Private analysts, solar and environmental advocates, government agencies such as the former Congressional Office of Technology Assessment, and some industry groups argue vigorously that renewable energy will be the cornerstone of future energy systems.³⁴ Thus, understanding the history and dynamics of solar energy policy is important for understanding the possible changes in a technological system of great importance, now and in the future.

Energy policy mostly focuses on existing sources of energy, their accompanying technological ensembles, and the conflicts of their associated regional economic and political interests. For example, the coal industry for years opposed increasing the quotas of imported residual fuel oil, typically used for home heating, into the United States, fearing that such imports would cut into their market share.³⁵ In this type of conflict, well-established economic interests argue over policies that would affect their shares of wealth and income. The technologies and market structures involved are mature, the various interests have close, long-term relations to government agencies, and everyone acts as if they have a clear idea of which policies will advance their economic interests and which ones will not.

In contrast, policy debates over solar energy are arguments over the shape of a large future technological system. Such policies necessarily confront immense uncertainties about interests and outcomes. This class of policies affects, in addition to energy, many of the most consequential technological systems of our time, including environmentally clean manufacturing, rapid changes in agriculture wrought by advances in biotechnology, and the linkages and developments in telecommunications and information technologies. Policies that governments adopt now will influence billions of dollars of investment in complex technological systems that will become constitutive parts of our society for years to come. The approach I take to this case thereby provides insights for analyzing some of these other issues.

CRITIQUE OF THE POLICY-MAKING PROCESS

Those who wish to challenge prevailing public policy must be able to challenge the sets of ideas that underlie the status quo. A democratic technology policy cannot content itself with giving citizens a set of cookie-cutter choices but must instead empower them to contest the underlying judgements and ideas that constitute those choices.³⁶ Woodhouse and Collingridge stress that intelligent democratic processes must take into account the views of diverse partisans, lest unwise policies go unchallenged. Clearly, partisans who cannot challenge institutionalized ideas have very little scope for challenging policies in general. Hajer

argues persuasively that substantial changes in policy require the dominance of new discourse coalitions, which entails institutionalizing new ideas.³⁷

Langdon Winner addresses the problem that philosophical and other theoretical analyses seem to have little effect on the technologies that our societies produce, even when some actors in the system recognize that ethical and other normative issues will be greatly affected by the new technologies. Winner concludes that “the trouble is not that we lack good arguments and theories, but rather that modern politics simply does not provide appropriate roles and institutions in which the goal of defining the common good in technology policy is a legitimate project.”³⁸ This study takes Winner’s critique seriously and asks why various technology policy processes, including those that provide channels through which advocates can participate, do not provide the deliberative institutions and roles that Winner calls for. In constructing technologies we do construct our future, and so our policies for the future, if they are to be democratic, require that citizens be able to challenge the institutionalized ideas that underlie the status quo.

